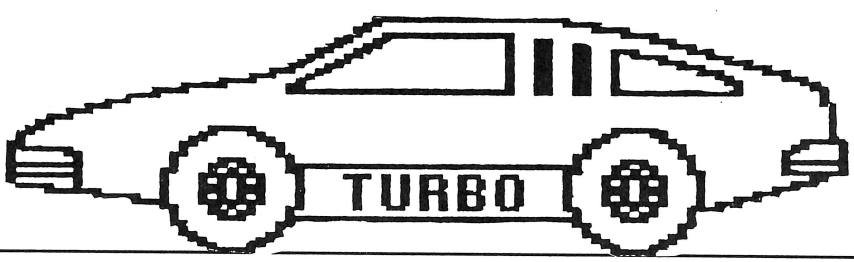
CAR BUILDER™

User Guide



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CAR BUILDER™
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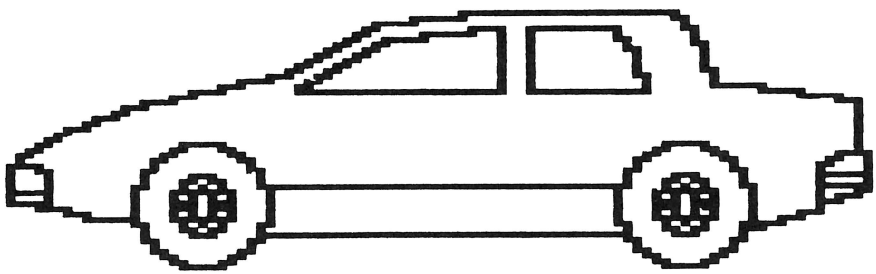


Welcome to CAR BUILDER, a scientific simulation program that lets you design, construct, modify, and test your own cars.

This guide will provide you with detailed instructions on building a simulated vehicle. First you design the mechanical (insides) of the car, selecting chassis length, fuel tank, gear ratios, tires, etc. When the mechanical selection is complete, you design and modify the body of the car, add decorative and functional touches, and run the car through a full testing procedure, including a wind tunnel and a test track. At the end of the testing section you can save your car to disk. All the information about your car and its performance will be stored, and you may view and compare your creations.

You can design station wagons, sedans, vans, and sports cars. Select for aerodynamics, power and racing ability, or economy and fuel efficiency.

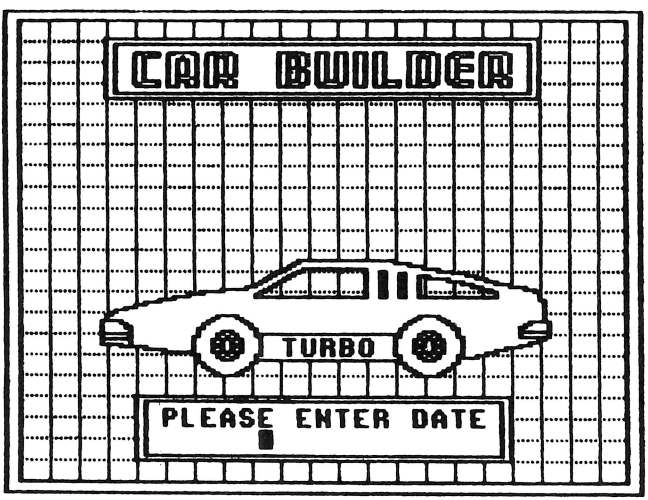
Comparing the test results on modified models allows you to see the effect of improvements as you design. We have included a fully designed car, the SPYDER, on your disk. Take a look at it after you have finished your first designs. SPYDER is a hot little number, see if you can improve it.

How To Start

Car Builder will run on any Macintosh LC or LCII with an Apple IIe card installed, or the Apple II family (IIGS, IIc+, IIc, IIe, II+, II). 3.5" and 5.25" disks available. 5.25" require 48K, 3.5" require 64K. Please see your warranty/registration card for information on obtaining a backup copy.

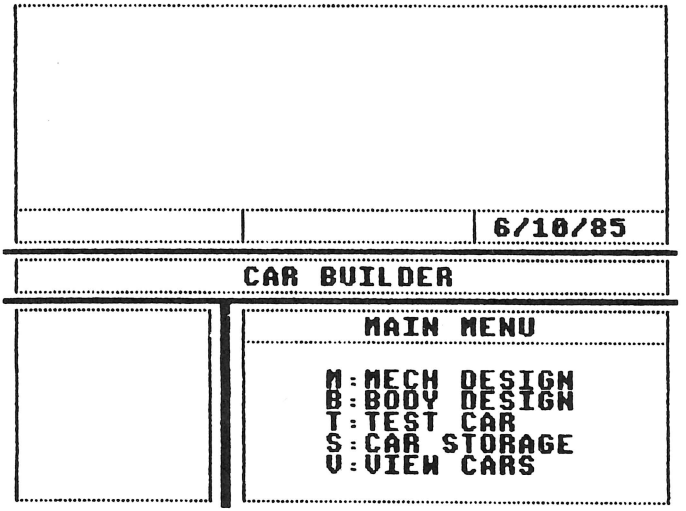
If you have an Apple IIc or Apple IIe, make sure the CAPS LOCK key is down. To start, put the program disk into the drive and turn on your computer. If you have Autostart, you will see the title panel displayed.

If your Apple does not have Autostart ROM, you will see the monitor cursor *. Type 6, then type P while holding down the key marked CTRL (6 CTRL P), then press the return key. The title panel will be displayed, and you will see PLEASE ENTER DATE. You can enter the date in any form, as long as it uses no more than eight characters.



When you have entered the date, press the RETURN key to proceed to the MAIN MENU.

THE MAIN MENU



The CAR BUILDER screen is divided into four sections.

The top section will display the car parts as you select them and allow you to view the completed car.

The middle section displays the date; model name; and, in the disk storage module, information about the number of storage cells free.

The CAR BUILDER title section is used to display the choices available for selection (chassis, engine, etc.) or the module you are working in (disk access).

The menu section at the bottom of the screen presents information or instructions on the left and the choices available for the particular module you are working with on the right. The menus will change as you move through the various sections of the program; and you may press the letter X to return to the previous menu.

The MAIN MENU gives you the options of building the mechanicals of the car, building the body, testing the car, using the disk storage capabilities, or viewing cars that have been saved to the disk.

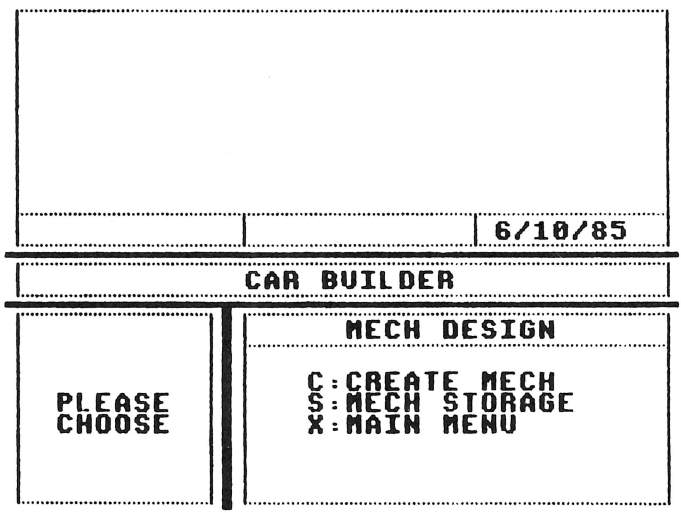
Although you can choose any option from the MAIN MENU, as a first-time builder it's best to begin by designing the underlying mechanical structure of your car. If you selected body parts first, for

example, you might not be able to fit in the engine or gas tank that you want.

To select the mechanical components of your car, choose M for MECH DESIGN. This will bring you to the MECH DESIGN MENU.

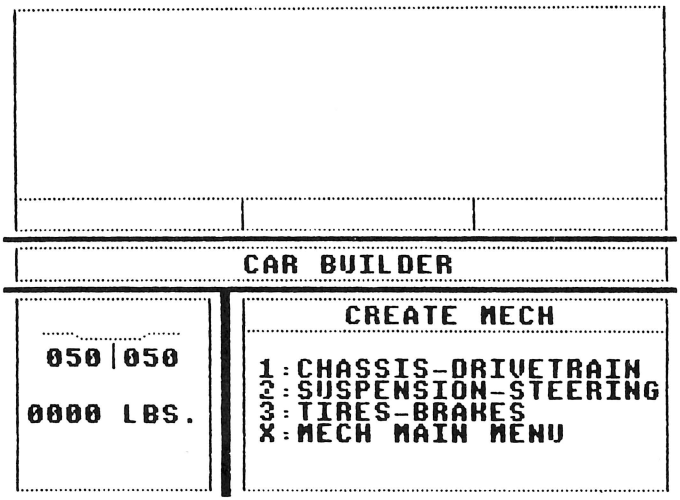
MECHANICAL DESIGN

From the MECH DESIGN MENU you can create the mechanicals, have disk access, or return to the MAIN MENU by pressing the letter X.

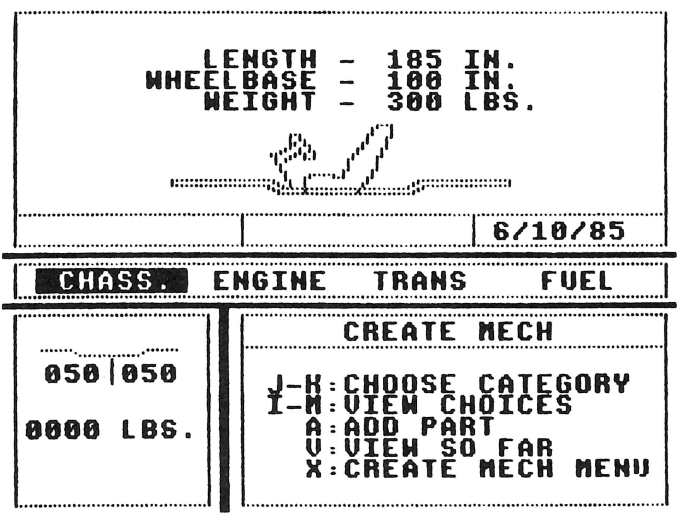


Press the letter C to begin designing your car. You will see the options available in the CREATE MECH MENU.

There are three sections to select from when creating the mechanicals for your car: CHASSIS, SUSPENSION, and TIRES. You must choose parts from each of these sections to have a complete mechanical design. You may choose the parts in any order; but because the selection of certain components will affect the other choices available to you, let's begin with number 1, the CHASSIS, for the widest range.



When you press 1, you will see four subcategories listed. These are, CHASS(IS), ENGINE, TRANS(MISSION) and FUEL(TANK). By pressing the J, K, left or right arrow key, you will see each of the categories highlighted in turn within a black box.



Choose the category you want to begin with by placing the black box on the appropriate word.

Let's begin with the chassis. After the word CHASSIS has been highlighted, press the I or M, up or down arrow key to view all the available sizes. As you step through the choices, information on each chassis will be given to you along with a picture. Each chassis has very different characteristics — from short (two-seater) to extra long (station wagon or van).

To select a particular chassis for your car, press the A (ADD PART) key.

The panel to the left of the menu now displays a weight distribution chart. This shows you the percentages of weight in the front and rear of the car. Below that is the cumulative weight of the car with the parts you have chosen. As you add more pieces to the car, these numbers will change.

There are notes on each component in the "Available Components" section at the end of this manual. The implications of choosing one part over another are explained. Some parts may be better suited than others for the type of car you want. Experimenting will help you to determine the best choices.

You may choose the V (VIEW SO FAR) option at any time during the mechanical design phase to display your car with the parts you have chosen. Press the RETURN key to continue building your car.

To continue selecting the mechanical components for your car, follow the same procedure for choosing the engine as you did for the chassis. Use the J or K, left or right, arrow key to highlight the word ENGINE. Step through the engine choices by pressing the I or M, up or down arrow key. Select the engine you want by pressing the A key.

Choose the transmission and the fuel tank in the same manner.

When you have selected all the parts in the CHASSIS-DRIVETRAIN section, the computer will tell you that all parts have been chosen. Press the RETURN key to continue.

The RETURN key brings you back to the CREATE MECH MENU.

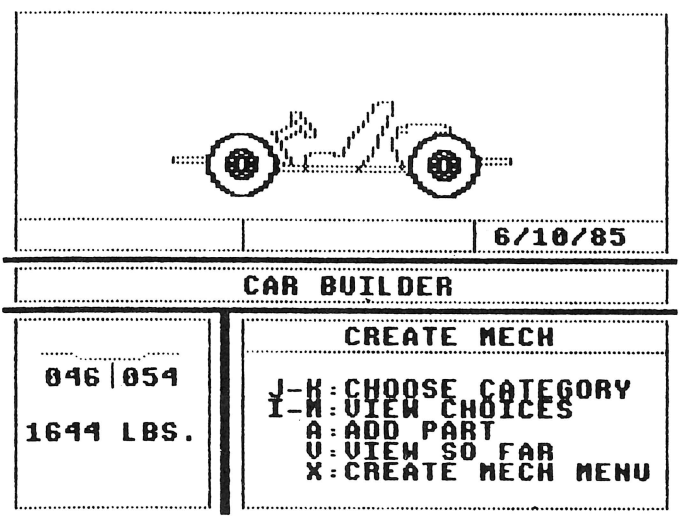
You have completed section 1, and should now proceed to section 2: SUSPENSION-STEERING. The standard suspension fitted for each car includes MacPherson struts, coil springs, and tube shocks in the

front and trailing arms with coil springs and tube shocks in the rear. You can add various suspension options to improve handling and comfort. You will also select the steering mechanism in this section. Once again, use the J or K, left or right arrow key to highlight the category; the I or M, up or down arrow key to view the choices in that category; the A key to add the part to your car; and the V key to view the options you have chosen so far. When you have completed the suspension, press the RETURN key to return to the CREATE MECH MENU.

The third heading under the mechanical design is TIRES-BRAKES. In this section, you will choose the front and rear tires and the front and rear brakes. Follow the procedure described above to select the parts.

If you attempt to exit the CREATE MECHANICAL section before all parts have been selected, a warning will be displayed on-screen to prevent you from losing the incomplete design unless you wish to.

When you have completed the mechanical design, you will see a picture of the chassis, complete with engine, dashboard, seats, and wheels.



The other option in the MECHANICAL DESIGN section is the MECH STORAGE option. You may use this option to load, save, or

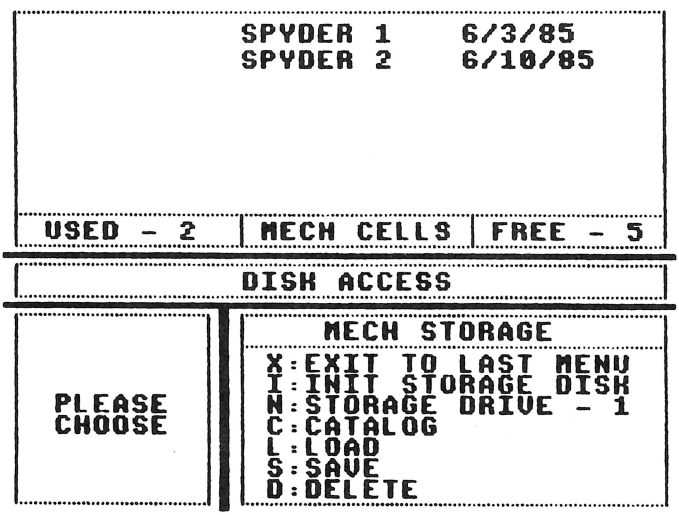
delete a mechanical design or to initialize a disk. Although it is not necessary to save your mechanical design at this time, you may want to so you can have the use of this mechanical on a number of body designs.

Press S to enter the STORAGE MENU.

STORAGE MENU OPTIONS

There are STORAGE MENU sections available for each of the main segments in CAR BUILDER. You may store only mechanicals in the MECH STORAGE section, only bodies in the BODY STORAGE section, and completed cars in the CAR STORAGE section.

The CAR BUILDER disk (or any disk initialized by the CAR BUILDER init option) allows for a total of 21 storage cells, seven cells each for the mechanicals, the body designs, and the completed and tested cars. Each of the storage utilities works in the same manner.



The upper part of the MECH STORAGE screen catalogs the mechanicals already saved to disk by model name and date. The section below the list indicates how many of the seven available MECH CELLS have been used and how many are free.

The menu below the DISK ACCESS title displays the MECH STORAGE options available to you.

X — EXIT TO LAST MENU

Press X to return to the previous menu.

I — INIT STORAGE DISK

There is room on your CAR BUILDER disk to store seven each of mechanicals, bodies, and cars. You may create as many CAR BUILDER storage disks as you like by using the INIT STORAGE DISK command to format blank disks. The INIT command will destroy any information on the disk, so be sure to use it only on blanks or on disks you want to write over. DO NOT USE THE INIT STORAGE DISK COMMAND TO INITIALIZE YOUR CAR BUILDER MASTER DISK! If you have one drive, be sure to remove your CAR BUILDER disk and replace it with a blank. If you have two drives, set the toggle command (N) to drive 2, (see below).

To initialize a disk, press the letter I and follow the instructions given to you by the computer. The disk will be initialized in CAR BUILDER format. The storage cells for the mechanicals, body designs, and completed cars will be set up. You can save CAR BUILDER files only on a disk initialized by the INIT STORAGE DISK command.

N — STORAGE DRIVE — 1

The STORAGE DRIVE toggle option is designed for users with two drive systems. Press N to change the drive you are accessing from drive 1 to drive 2 and back. Use the toggle to save, load, and catalog files or to initialize blank disks on your second disk drive.

C — CATALOG

Pressing the letter C enables you to catalog the disk in the drive you are accessing. The mechanical designs saved on that disk will be listed. (When you use the disk storage utilities in the body design section, only the body designs saved on the disk will be listed. When cataloging the disk from the main storage menu, the completed and tested cars will be listed.)

L — LOAD

To load a file from the disk, press the letter L. A black "LOAD" cursor will appear at the left of the file names. Use the I or M, up or down arrow key to move the cursor over the files. When the cursor is on the file you wish to load, press the RETURN key. (Note: This will wipe

out any mechanical file currently in memory.) If you decide not to load in a file, press the X key instead of the RETURN key to return to the MECHANICAL DESIGN MENU.

S — SAVE

Press S to save the mechanical you have just created on the disk. The computer will ask you for the file name (model name) of your mechanical. Type in any name, using up to ten characters. The file will be placed in an empty storage cell (not necessarily the last name in the catalog).

SAVING A FILE WILL NOT OVERWRITE A FILE WITH THE SAME NAME. You may name your models differently (Turbo 1, Turbo 2, etc.) to avoid confusion. If you want to replace one model with another of the same name, first delete the old model (see "Delete" below), then save the new one. If you are working on improving a model at a later date, the old one will remain on disk when you save the new one with the same name. In this way, you can see how a model has changed over a period of time.

Only the file under the cursor will be deleted; you will not lose all the cars with the same model name.

D — DELETE

To delete files, press the letter D. A black "DELETE" cursor will appear at the left of the file names. Use the I or M, up or down arrow key to move the cursor over the files. When the cursor is on the file you wish to delete, press the RETURN key. If you do not wish to delete a file, press X to return to the MECHANICAL DESIGN MENU.

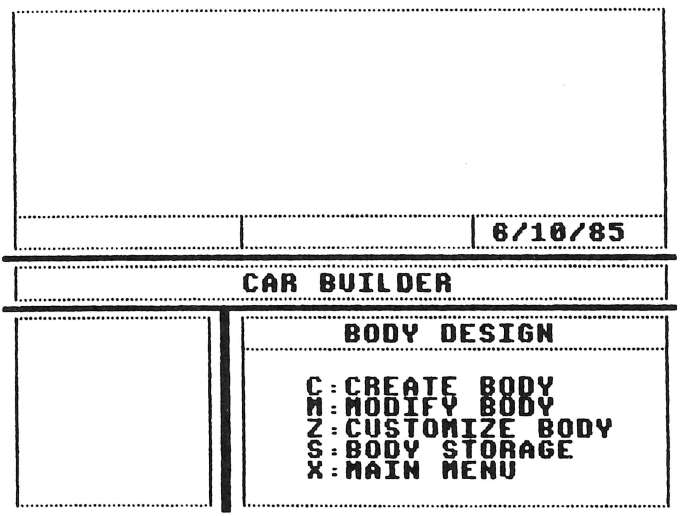
Press the letter X to return to the MAIN MENU.

The next phase is the BODY DESIGN section of CAR BUILDER. You need to complete both the mechanical and the body design before you can test your car.

Although it is not required that you design the mechanicals first, it is the best method to use. CAR BUILDER can show you only the relationship between the body panels chosen and the internal

structure of the car if it has the mechanical portions already stored in memory. If you designed the body first, you would be able to view all the body panels, not just the ones that fit your car, and the selection process would be more cumbersome.

BODY DESIGN

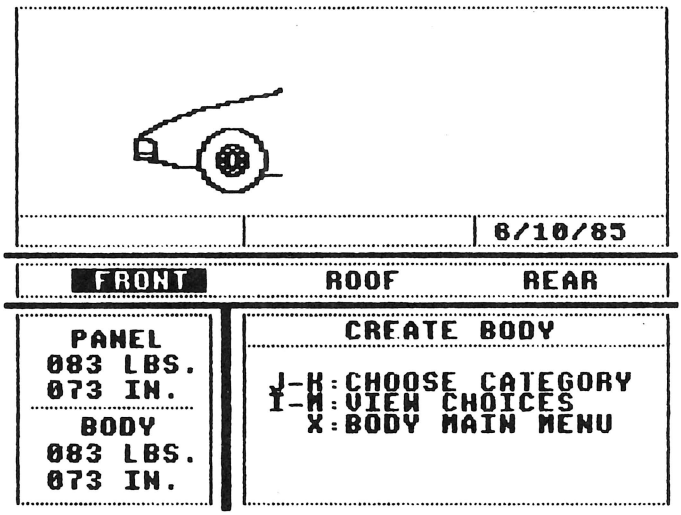


Press the letter B from the MAIN MENU to begin designing the body. The BODY DESIGN MENU will appear. Choose C to begin creating your new body.

There are only three body segments to select: the front, the roof, and the rear.

Just as you did in the MECHANICAL DESIGN section, press the J or K, left or right arrow key to choose the category (FRONT, ROOF, or REAR). When the section you want to design is highlighted within the black box, use the I or M, up or down arrow key to step through the choices in that category.

There is no need to press the letter A to add a body part in this section. Move the black cursor to select the next body segment. By pressing the J or K, left or right arrow key, you can move back to change a body segment (e.g., get a different front section).



Once again, notice that to the left of the menu information is given about the car as you select the body segments. The weight and size of the new panel you are viewing is given as well as the cumulative weight and the length of the full body.

When you are satisfied with the initial body design, press X to return to the BODY DESIGN MENU.

Another option in the BODY DESIGN MENU is to modify the body you have just made. While it is not necessary to modify a body, certain design goals, such as improved aerodynamics or reduced weight ratios, can be achieved only by careful modification. It is also true that most designers prefer their own creation to the prepackaged effort of others. You can change the whole look of the car by modifying the body.

You may want to save the original body design you selected now, in case you make any major changes that you don't like.

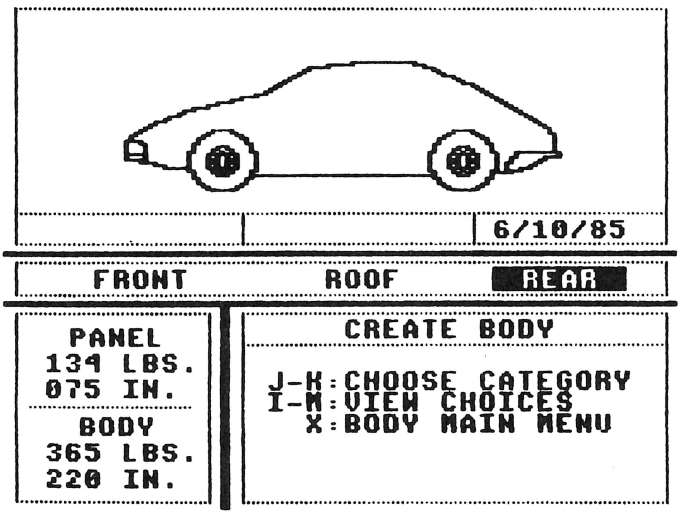
From the BODY DESIGN MENU, press the letter S for BODY STORAGE.

The BODY STORAGE MENU options operate in exactly the same way as the MECH STORAGE options we discussed in the last section. You can use X to exit to the last menu, I to initialize a new storage disk (remember to be careful), N to toggle drives (for two drive systems), C to catalog the body designs on the disk, L to load a

design (remember that loading a design wipes out the current design in memory and that a body that does not fit the mechanical also in memory will produce an error message), S to save a body to disk, and D to delete a body from the disk.

To save your current body design, press S. The program will ask for a model name. Type a name for your body and press RETURN. The name you assign and the date you entererd at the beginning of the program will both be displayed when the body is saved to disk.

Press X to return the BODY DESIGN MENU.

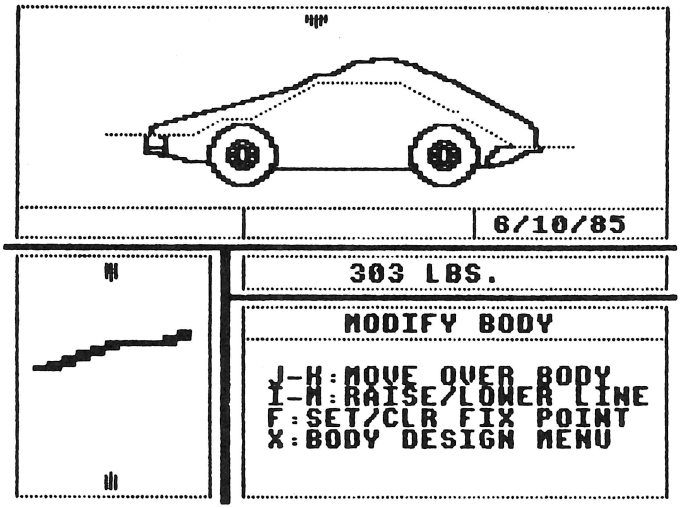


BODY MODIFICATION

Now you are ready to begin modifying your car. From the BODY DESIGN MENU, press M to enter the MODIFY BODY section. The MODIFY section can be used only when there is a mechanical already in memory.

At the top of the screen, you will see the body you have selected for your car. Pressing the J or K, left or right arrow key will move the blue arrow along the body of the car.

The display in the lower left corner of the screen is a closeup view of the body section that is below the blue arrow. To modify the car, place the blue arrow directly above the portion you want to change.



Pressing the I or M, up or down arrow key will raise or lower the body line at the cursor. It takes practice to perfect the body modification technique; but once you get the hang of it, you will see that you can create a very wide variety of body types. You might want to try counting patterns for curved or stepped areas, such as two over, one down; two over, one down.

A series of orange lines appears across the car body in the Modify mode. These lines indicate the relative position of the mechanical (engine, chassis, etc.) portions already chosen. Modifications can be made only down to the orange line. These lines represent the top of the engine, the steering, and the seating sections of the car. If the body went below the orange line, the engine would protrude through the body.

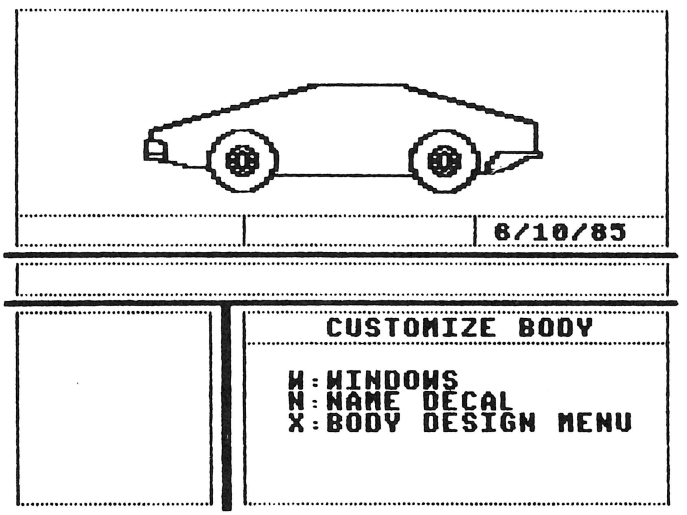
One trick that can be used when modifying a body is to press the letter F to a point along the body line. The point is represented by a green dot on the closeup section of the car. This means that that particular point can no longer move. Any subsequent modification will be made in relation to that fixed point. To clear a fixed point, just press the F key again while the arrow is directly above the green dot. There is no limit to the number of points you can fix on a car.

When all your modifications are complete, press the X key to return to the BODY DESIGN MENU. You can now choose to customize the

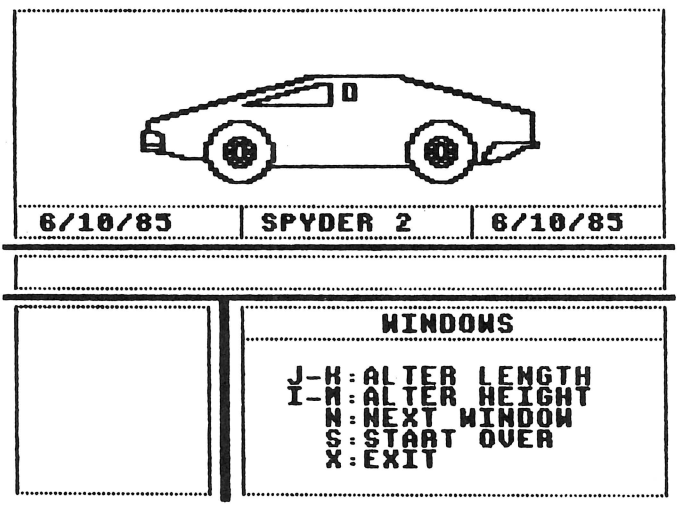
modified body of your car or to load in your original body design if you saved it to the disk.

To reload your original body, press the S key to access the disk options. If you choose to load in a different body from the disk, the mechanical information you have in memory at this time will remain intact. If the body you select is not compatible with the mechanical design in memory, the program will tell you to select another body or to design a new one from scratch. The modifications will be wiped out when you load a new body in from the disk.

To customize the car body, press Z while you are in the BODY DESIGN MENU. One of the available options in customizing the car body is adding windows. While in the CUSTOMIZE BODY MENU, press W to select the window option.

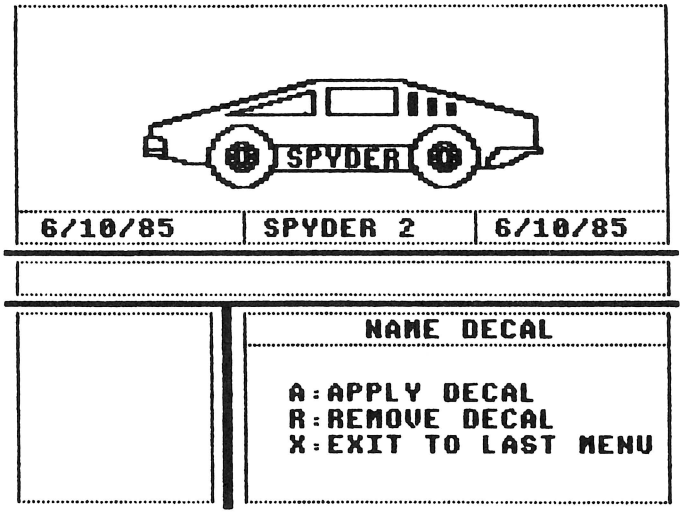


The windows are drawn from the front to the back. The first window, usually triangular, will always follow the front-end design. The J or K, left or right arrow key can be used to alter the length of the window across the body of the car. The I or M, up or down arrow key will alter the height of the window. When you have completed a window, press N to begin work on the next window. If you want to start the window design all over, press S. Vertical louvers can be made by designing windows with no added width. (Use the I, M keys then use N to do the next louver.)



When you have completed your window design, press X to return to the CUSTOMIZE BODY MENU.

The second option in the CUSTOMIZE BODY MENU can be used to place your name, the model name, or anything else directly on the car. Press N to choose this option. Press A to apply a decal to the bottom side of you car then type in the name. You can use the left arrow key to back up and correct any misspelling. When you press RETURN, the decal will be placed on the car. To remove decal, press the R key.



When you have finished applying the decals, press X to return to the CUSTOMIZE BODY MENU, press X again to get to the BODY DESIGN MENU. (As you can see, each time you press the letter X you return to the last menu.) You can store the car body at this point by choosing the S (BODY STORAGE) option. It is not necessary, however, to save the body at this time.

Once again, press X. This time you will return to the MAIN MENU.

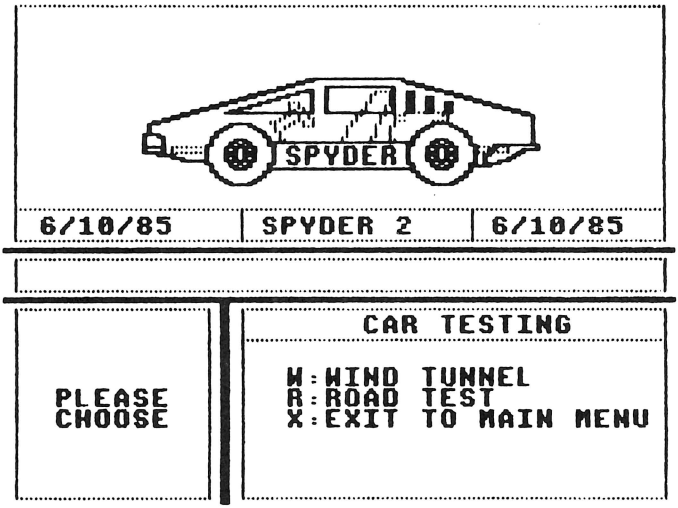
The final phase in designing your car is the testing phase. Press T to select the TEST CAR option.

TESTING YOUR CAR

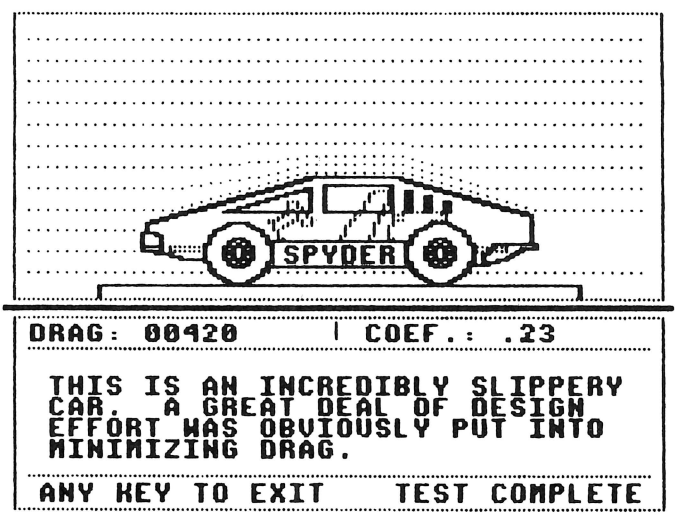
A finished car design requires three components: a complete mechanical design, a complete body design, and test results.

The CAR TESTING section allows you to run the car you have designed though two test procedures, the wind tunnel and the road test.

Test results will be given at the conclusion of each test.



You must use the wind tunnel before you take your car out on the road. Press W to enter the wind tunnel. Your car will be placed on a platform inside the tunnel, and you will be able to view the pattern of air being forced through the tunnel. You can see how the body design affects the aerodynamics and, consequently, the handling of your car. A smooth flow of air across your car will make it perform efficiently.

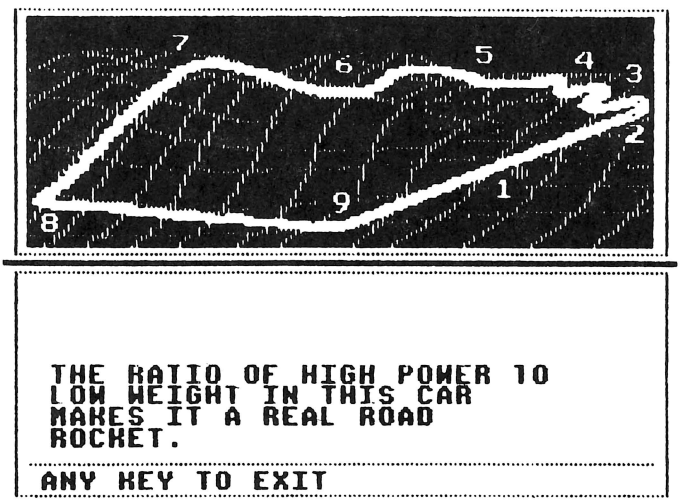

SPYDER
DRAG: 00420
COEF.: .23
THIS IS AN INCREDIBLY SLIPPERY CAR. A GREAT DEAL OF DESIGN EFFORT WAS OBVIOUSLY PUT INTO MINIMIZING DRAG.
ANY KEY TO EXIT
TEST COMPLETE

When the test is complete, the drag and drag coefficient will be calculated for your car. The test is designed to simulate real life, so the results you see are accurate for the type of car you designed. An actual car with the same design would have similar results in a real wind tunnel.

The engineering staff will then provide a comment on the relative merit of your body design.

Press any key to proceed to the next test.

Press the R key to put your car through the road test. The test driver will take your car through the course outlined at the top of the screen. As the driver puts the car through the curves, down the straightaways, and over the hills, an evaluation will be performed on all the mechanical and external parts you have selected.



The driver will relay messages during the test; and at the end of the test, a report will be given to you on the car's handling characteristics.

Technical data on the car's performance characteristics will be presented after the comments from the driver have been noted.

Remember, there is no perfect car. All test data should be reviewed by you with the design goals you set for your car in mind. A racing sports car with a large engine and low body weight should perform differently from a solid, fuel-efficient, five-passenger sedan.

When the TEST COMPLETE signal is given, you may press any key to return to the CAR TESTING MENU. Press X to return to the MAIN MENU.

At this point — after the mechanical selection, the body design, and the testing have been completed — we suggest that you save your car to disk. Use the S (CAR STORAGE) option to do this.

The CAR STORAGE MENU functions exactly like the MECHANICAL STORAGE MENU described earlier. The only difference is that the options in CAR STORAGE pertain to complete car designs (mechanicals, body designs, and test results).

The CAR BUILDER disk (or any disk initialized by the CAR BUILDER init option) allows for a total of 21 storage cells, seven cells each for the mechanicals, the body designs, and the completed and tested cars. Each of the storage utilities works in the same manner.

The upper part of the CAR STORAGE screen catalogs the cars already saved to disk by model name and date. The section below the list indicates how many of the seven available CAR CELLS have been used and how many are free.

The menu below the DISK ACCESS title displays the CAR STORAGE options available to you.

X — EXIT TO LAST MENU

Press X to return to the previous menu.

I — INIT STORAGE DISK

There is room on your CAR BUILDER disk to store seven each of mechanicals, bodies, and cars. You may create as many CAR BUILDER storage disks as you like by using the INIT command to format blank disks. The INIT command will destroy any information

on the disk, so be sure to use it only on blanks or on disks you want to write over. DO NOT USE THE INIT STORAGE DISK COMMAND TO INITIALIZE YOUR CAR BUILDER MASTER DISK! If you have one drive, be sure to remove your CAR BUILDER disk and replace it with a blank. If you have two drives, set the toggle command (N) to drive 2, (See below).

To initialize a disk, press the letter I and follow the instructions given to you by the computer. The disk will be initialized in CAR BUILDER format. The storage cells for the mechanicals, body designs, and completed cars will be set up. You can save CAR BUILDER files only on a disk initialized by the INIT STORAGE DISK command.

N — STORAGE DRIVE — 1

The STORAGE DRIVE toggle option is designed for users with two drive systems. Press N to change the drive you are accessing from drive 1 to drive 2 and back. Use the toggle to save, load, and catalog files or to initialize blank disks on your second disk drive.

C — CATALOG

Pressing the letter C enables you to catalog the disk in the drive you are accessing. The complete cars saved on that disk will be listed.

L — LOAD

To load a file from the disk, press the letter L. A black "LOAD" cursor will appear at the left of the file names. Use the I or M, up or down arrow key to move the cursor over the files. When the cursor is on the file you wish to load, press the RETURN key. (Note: This will wipe out any car file currently in memory.) If you decide not to load in a file, press the X key instead of the RETURN key to return to the CAR STORAGE MENU.

S — SAVE

Press S to save the car in memory to the disk. The computer will ask you for the file name (model name) of your car. Type in any name, using up to ten characters. The file will be placed in an empty storage

cell (not necessarily the last name in the catalog.)

SAVING A FILE WILL NOT OVERWRITE A FILE WITH THE SAME NAME. You may name your models differently (Turbo 1, Turbo 2, etc.) to avoid confusion. If you want to replace one model with another of the same name, first delete the old model (see "Delete" below) then save the new one. If you are working on improving a model at a later date, the old one will remain on disk when you save the new one with the same name. In this way, you can see how a model has changed over a period of time.

Only the file under the cursor will be deleted; you will not lose all the cars with the same model name.

D — DELETE

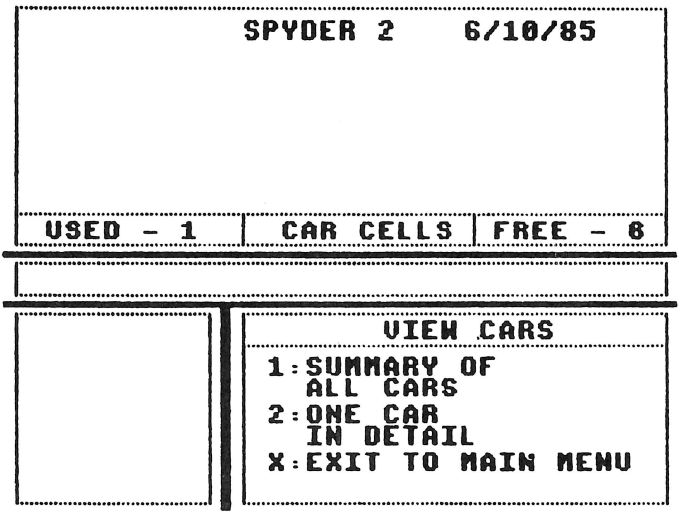
To delete files, press the letter D. A black "DELETE" cursor will appear at the left of the file names. Use the I or M, up or down arrow key to move the cursor over the files. When the cursor is on the file you wish to delete, press the RETURN key. If you do not wish to delete a file, press X to return to the CAR STORAGE MENU.

Press the letter X to return to the MAIN MENU.

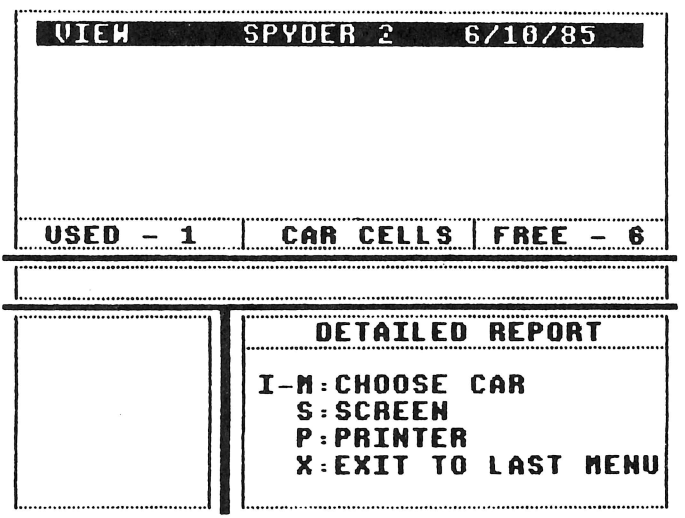
Choose the S option to save your car out to disk. You will be asked to enter the model name. The program will insert the name of your car into one of the empty CAR CELLS. If there is no room on the disk, you can either delete one of the cars or you can initialize another storage disk.

VIEWING THE CARS

The fifth and final option on the MAIN MENU is the V (VIEW CARS) option. This allows you to look at the cars that have been saved to disk. You can either have a general summary of all the cars on the disk or a detailed report on any one car.



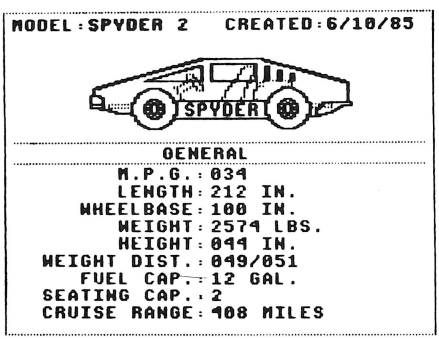
Choose option 1 to see all the cars on the disk. At the top of the screen, you will see the name of the car and the date it was created as well as a picture of the car. The general information consists of the length, wheelbase, weight, height, weight distribution, fuel capacity, and seating capacity of the car.

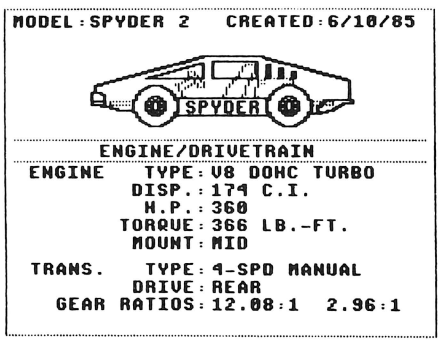


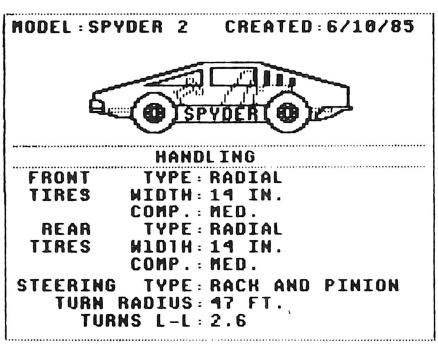
Press any key to view the next car. The program will display only the cars that have been saved as a complete package (mechanicals, body designs, and test results). When all the cars have been shown, the program will return to the VIEW CARS MENU.

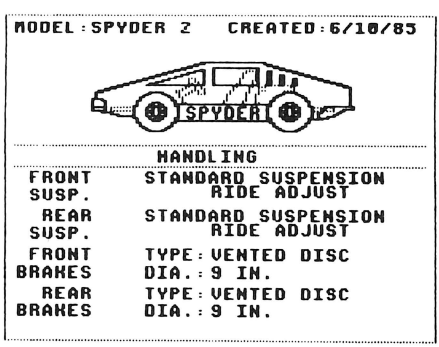
To view one car in detail, choose option 2. Use the I or M, the up or down arrow key to highlight the car you want to view in detail. Press the S key if you want the information to be displayed on the screen.

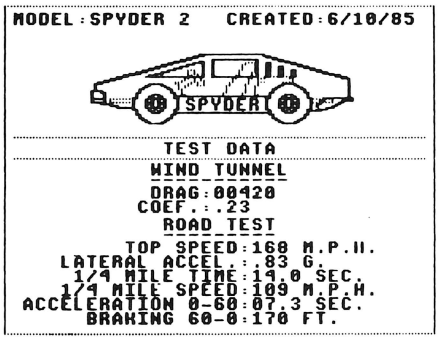
If you have a printer that will do graphics (Apple Dot Matrix, Imagewriter, Scribe, C.Itoh Prowriter, or Okidata), you can print out the detailed data sheets. Just select the P (PRINTER) options and answer the questions about your printer and interface card.











You can store as many disks of completed or mechanical and body only car designs as you like. The VIEW option will let you page through the completed cars for comparisons.

You may go back into the program and modify a body to get better test results. If you want to modify the mechanical design, however, you must rebuild the mechanicals from scratch. You can use the VIEW ONE CAR IN DETAIL option to get a detailed record of the mechanical options chosen and rebuild with modifications, or you can load a mechanical you have saved on the disk and redesign the body around it.

There are no limits to the number of cars you can develop by creating new models, interchanging parts, and modifying bodies.

In the last section of the guide, we will describe the choices available to you in each section of CAR BUILDER and offer some advice on designing cars.

HAPPY CAR BUILDING!

AVAILABLE COMPONENTS

CAR BUILDER provides a wide choice of individual components from which you may assemble your car. Remember, there is no perfect car. You should design your vehicles with various goals in mind. A designer seeking to produce a comfortable, five-passenger car with good fuel economy will select far different components from one whose goal is a superfast sports car with a seating capacity of two.

You may use the test data readouts for comparing the cars you design. Pay particular attention to range, top speed, braking, etc.

The test driver's comments may be of use to you in determining how well your goals have been achieved.

The following tables illustrate the range of choices available. Not all components are usable in all cases. The chassis, once selected, determines the size and mounting position of the engine choices you can make. The engine affects the transmission and so on throughout the process.

CHASSIS

Long chassis allow for more seating and a wider variety of engines and engine positions. Short chassis save weight.

LENGTH	WHEELBASE	WEIGHT
185 IN	100 IN	300 LB
190 IN	105 IN	400 LB
190 IN	105 IN	450 LB
195 IN	110 IN	550 LB
200 IN	115 IN	650 LB
205 IN	120 IN	750 LB
205 IN	120 IN	800 LB

ENGINES

You can use this chart to help in selecting the engine best suited to the car you are designing. TYPE describes the basic engine. L4 DOHC is an inline 4-cylinder, double overhead cam engine. SOHC means single overhead cam, L5 is an inline five-cylinder; V6 OHV is a v-block, six-cylinder overhead valve engine; etc.

The figures for displacement, horsepower, and torque will guide you in selecting the engine with the proper balance of power for the car you are designing. Horsepower will affect top speed and acceleration. Torque will affect acceleration at low engine speeds. Mounting position and weight are also important design considerations and will affect handling. Try different engines in similar cars to see the effect of changing these factors.

TYPE	DISPLACEMENT	HORSEPOWER	TORQUE	MOUNT	WEIGHT
L4 DOHC	96.8 CU IN	130	110 LB-FT	MID	360 LB
L4 DOHC	97 CU IN	112	97 LB-FT	FRONT	340 LB
L4 SOHC	96.8 CU IN	70	85 LB-FT	FRONT	300 LB
L4 SOHC	97.4 CU IN	72	85 LB-FT	MID	300 LB
L4 SOHC	109 CU IN	85	98 LB-FT	FRONT	320 LB
L4 SOHC	143 CU IN	101	131 LB-FT	FRONT	340 LB
L4 SOHC TURBO	110 CU IN	142	160 LB-FT	FRONT	385 LB
L4 SOHC TURBO	121 CU IN	135	160 LB-FT	MID	375 LB
L5 SOHC	136 CU IN	115	126 LB-FT	FRONT	345 LB
L6 SOHC TURBO	168 CU IN	180	202 LB-FT	MID	460 LB
V6 OHV	170 CU IN	150	159 LB-FT	FRONT	430 LB
V6 OHV	173 CU IN	140	170 LB-FT	MID	400 LB
V8 DOHC	179 CU IN	230	188 LB-FT	MID	585 LB
V8 DOHC TURBO	174 CU IN	360	366 LB-FT	MID	690 LB
V8 SOHC	234 CU IN	155	196 LB-FT	FRONT	500 LB
V8 SOHC	273 CU IN	220	254 LB-FT	FRONT	570 LB
V8 OHV	302 CU IN	157	240 LB-FT	FRONT	520 LB
V8 OHV	305 CU IN	180	240 LB-FT	FRONT	545 LB
V8 OHV	350 CU IN	200	285 LB-FT	FRONT	575 LB
V8 OHV	351 CU IN	350	333 LB-FT	FRONT	640 LB
V8 OHV	351 CU IN	350	333 LB-FT	MID	640 LB
V8 OHV	460 CU IN	370	465 LB-FT	FRONT	800 LB
V8 OHV	460 CU IN	370	465 LB-FT	MID	800 LB

TRANSMISSION

The transmission has an overall effect on the car's performance and relates to the engine chosen. The four-wheel drive is a transmission for off-road use.

TYPE	MOUNT	WEIGHT	GEAR RATIO HIGH	LOW
4-SPEED MANUAL	REAR	270 LB	12.08:1	2.96:1
4-SPEED AUTOMATIC	REAR	440 LB	17.27:1	2.47:1
5-SPEED MANUAL	FRONT	314 LB	13.21:1	2.72:1
5-SPEED MANUAL	REAR	440 LB	8.03:1	2.23:1
5-SPEED MANUAL	4-WHEEL DRIVE	520 LB	20:1	4:1

FUEL TANKS

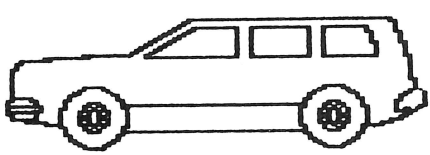
Cruising range and overall weight and balance are affected by the choice of fuel tank.

GALLONS	WEIGHT FULL	WEIGHT EMPTY	AVERAGE WEIGHT	MOUNT
12	88 LB	40 LB	64 LB	MID
12	88 LB	40 LB	64 LB	REAR
15	110 LB	50 LB	80 LB	MID
15	110 LB	50 LB	80 LB	REAR
18	132 LB	60 LB	96 LB	MID
18	132 LB	60 LB	96 LB	REAR
21	154 LB	70 LB	112 LB	MID
21	154 LB	70 LB	112 LB	REAR

SUSPENSION

The standard suspension includes MacPherson struts, coil springs, and tube shocks in front and trailing arms with coil springs and tube shocks in back. In addition, you can add one of the following to improve handling. The anti-roll bar and gas shocks will improve cornering. The ride adjust will allow for a more comfortable ride. Cars with ride adjust are tested on the track with the ride set to firm.

TYPE	WEIGHT
ANTI-ROLL BAR	50 LB
GAS SHOCKS	40 LB
RIDE ADJUST	45 LB



STEERING

TYPE	TURN CIRCLE	TURNS LOCK TO LOCK	WEIGHT
RECIRC. BALL	38.1 FT	2.9	155 LB
RACK AND PINION	39.9 FT	2.9	150 LB
RACK AND PINION	47 FT	2.6	140 LB
POWER ASSISTED	43.2 FT	3.5	210 LB
POWER ASSISTED	45 FT	3.0	203 LB

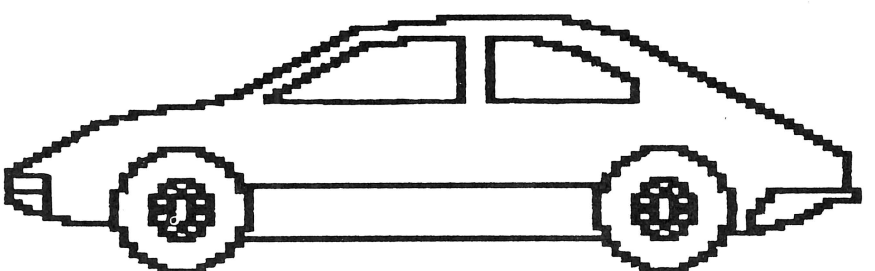
TIRES

Wide tires with soft composition give the best handling characteristics, but they also cause more wind and road drag. In general, radials perform better than belted tires. Slicks are used for racing.

TYPE	WIDTH	COMPOSITION	WEIGHT (EA)
RADIAL	8 IN	SOFT	30 LB
RADIAL	8 IN	MED	30 LB
RADIAL	8 IN	HARD	30 LB
BELTED	10 IN	SOFT	40 LB
BELTED	10 IN	MED	40 LB
BELTED	10 IN	HARD	40 LB
RADIAL	12 IN	SOFT	50 LB
RADIAL	12 IN	MED	50 LB
RADIAL	12 IN	HARD	50 LB
RADIAL	14 IN	SOFT	70 LB
RADIAL	14 IN	MED	70 LB
RADIAL	14 IN	HARD	70 LB
SLICK	18 IN	SOFT	90 LB
SLICK	18 IN	HARD	90 LB

BRAKES

The larger the brake, the shorter the stopping distance. Choose the largest disk brakes for high-performance cars with heavy engines. Vented disks resist heating better than nonvented disks and will be more consistent in repeated stops.

TYPE	DIAMETER	WEIGHT (EA)
VENTED DISK	8.5 IN	75 LB
VENTED DISK	8 IN	85 LB
VENTED DISK	9.5 IN	97 LB
VENTED DISK	10 IN	110 LB
NONVENTED DISK	8.5 IN	80 LB
NONVENTED DISK	9 IN	90 LB
NONVENTED DISK	9.5 IN	100 LB
NONVENTED DISK	10 IN	120 LB
DRUM	9.5 IN	70 LB

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